National Institute of Environmental Health Sciences

A regional-scale, high resolution dynamical malaria model that accounts for population density, climate and surface hydrology

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Abstract:

Background: The relative roles of climate variability and population related effects in malaria transmission could be better understood if regional-scale dynamical malaria models could account for these factors. Methods. A new dynamical community malaria model is introduced that accounts for the temperature and rainfall influences on the parasite and vector life cycles which are finely resolved in order to correctly represent the delay between the rains and the malaria season. The rainfall drives a simple but physically based representation of the surface hydrology. The model accounts for the population density in the calculation of daily biting rates. Results: Model simulations of entomological inoculation rate and circumsporozoite protein rate compare well to data from field studies from a wide range of locations in West Africa that encompass both seasonal endemic and epidemic fringe areas. A focus on Bobo-Dioulasso shows the ability of the model to represent the differences in transmission rates between rural and peri-urban areas in addition to the seasonality of malaria. Fine spatial resolution regional integrations for Eastern Africa reproduce the malaria atlas project (MAP) spatial distribution of the parasite ratio, and integrations for West and Eastern Africa show that the model grossly reproduces the reduction in parasite ratio as a function of population density observed in a large number of field surveys, although it underestimates malaria prevalence at high densities probably due to the neglect of population migration. Conclusions: A new dynamical community malaria model is publicly available that accounts for climate and population density to simulate malaria transmission on a regional scale. The model structure facilitates future development to incorporate migration, immunity and interventions.

Source: http://dx.doi.org/10.1186/1475-2875-12-65

Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Human Conflict/Displacement, Precipitation, Temperature

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Africa

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Intervention:

strategy to prepare for or reduce the impact of climate change on health

A focus of content

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation, Mitigation

Model/Methodology:

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Population of Concern: A focus of content

Population of Concern:

populations at particular risk or vulnerability to climate change impacts

Low Socioeconomic Status

Resource Type:

format or standard characteristic of resource

Research Article

Socioeconomic Scenario: Other Socioeconomic Scenario

Other Socioeconomic Scenario: Lower parasite ratio (PR) values in urban areas compared to rural areas due to a range of socio-economic factors that impact access to health facilities and treatment

Timescale:

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content